ESTIMATE THE RATE OF SHORELINE CHANGE USING THE STATISTICAL ANALYSIS TECHNIQUE (EPR)

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Abstract

Coastal areas are naturally dynamic with the changes occurring over periods of time. To monitor shoreline changes this study has been used digital shoreline analysis system (DSAS), which is an extension for Arc GIS 10.3 software developed by USUG. Several statistical methods are used to calculate the shoreline change rate with the most commonly used being end point rate (EPR) calculations. ERP calculations are simply the rates determined based on the changes in position between the oldest and the most recent shoreline a given dataset. A total of transects built in the Al Kabir-Al Shamali river estuary have values less than zero (i.e. the value of (EPR= -2.8) shows the highest retreating and outside of the error margin (± 10m), while the transect lines which have positive values higher than zero (i.e. advance shows of the highest degree in the Alfaid land region). The value of EPR (+1.81) shows the advanced shoreline and the transects are shown in gradients close to the red to indicate sedimentation.

Keywords

Shoreline, retreat, advance, sedimentation, erosion, GIS, DSAS, EPR

JEL Classification

C10, O44

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Introduction

Shoreline occurring between land and sea, is highly dynamic, and changes temporally and spatially in response to variations in influencing factors such as wind, wave tide, storm surge, sea level rise and land subsidence (Orford et al. 2002; Forbes et al. 2004; Cooper et al.2004)

The Syrian shoreline is critical important being a waterfront for the Syrian coast. The changes in the shoreline constitute a real and accelerated threats to the vital system in the Syrian coast (Görmüş et al. 2014).

Within 50 years, this shoreline witnessed an important changes. Therefore it is very important to record and monitor the shoreline changes continuously with the most advanced technologies to

develop a permanent perception and lasting consistent with future plans and projects for the development of the Syrian coast region and it's management.

Characterization of the study area

The Syrian coast is located between two latitudes of 34º.31 and ’35º.37’ north of the Equator circle and two longitudes of 36º.13´ and 35º.43´east Greenwich until the height(contour) line {250m} east in which the tyranny and recession of maritime had occurred in the Mediterranean. The existing marine sediments between the sea level and sea-level 250 m east of Jableh. Where the maximum nautical tyranny has occurred. The. Calabrian 150-250m (Al barouedi 1984).

The Syrian coastal region. Consisting of the coastal governorates Latakia and Tartous extend 183 long from RAS Al -bassit "Al bodursuy" to the end of Tartuts district "Al Araida" on the Lebanese border in the south. Divided into {93km} coast of latakia district and {90 km} of Tartous district.

Note that: the length (183 km) does not include the meanders in the shoreline and only represent an extension of basic lines which are a set of regular imaginary lines or straight lines related to the maximum points located on the minimum of the island toward the sea that separates the internal waters of the territorial sea. Figure 1 clarify the geographical reality of the study area.

Figure 1: The preparation of the student on the basis of satellite image. The ability of discrimination (1m).

Search tools and methods

Data of Remote sensing

The study mainly, depended on high -resolution satellite image (1m) Of (Ikonos) type. Taken in 2010 referent and geographically projection. Then the shoreline was drawn accurately to compare and match it with the shoreline drawn on the Aerial photo (white- black) taken in 1956. Note that all Aerial photos geo-referenced depending on the modern referent space photo in order to compare the land marks in the two photos, such as an intersection or corner of the building through the geographic information system(Arc-GIS.103). The errors associated with accuracy of vertical photography for Aerial photos, the

reflection of the image, the sources of other errors such as heat, height and pressure exerted on the camera and the overlap among all these errors can lead to distortions in the Aerial photo (Chaaban 2011).

So we concluded the margin of errors in this study about (1m) depending on the accuracy of the aerial photo. These errors were taken into account in the graph and the interpretation of the results.

Data processing

To determine the exact line of the beach and to monitor his changes is essential for planning and management of the coastal zone. In this study we compare between the two shorelines during (1958-2010) as follow: after the referent of the aerial photo depending on common points with the geo-referenced satellite image. Taking into the account the errors in referent within the allowed values. The written chips for the shorelines were established in the program (Arc-catalog) and then graphic in Arc-map.

These changes showed varying degree on the Ariel and satellite images. To identify the retreat areas in the shoreline and the areas where the land overcome the sea. Through the changes of erosion or sedimentation or actual human activity. On the basis of difference of and in the nature of the rocks. We identified five areas: Al Issawiyah area, Al faid land area, Al-kabir al-shamali river, Ibn Hani area, Albasia area.

The indicators used in the research

-EPR: (the rate of the end point) calculated by dividing the distance between the movement of the shoreline and time elapsed between the oldest and the latest measurements (the oldest and the newest shoreline) (Armaroli et al. 2014).

The main advantage for (EPR) is easily calculated and require the minimum amount of the coastal data (two shorelines). The main disadvantage is that in cases there is more than two shorelines. The information related to the conduct of the shoreline. Which provided by the additional beaches and the Changes in the size of the direction of the beach or the cyclical fluctuations of behavior be neglected. But in this study the data of two shoreline were used to overcome the technical defects.

DSAS: it stands for (digital shoreline analysis system)

It is intended for the analysis of digital for shoreline and it is an extension support the natural function of the program (ESRI ArcGIS). Users can calculated the statistics of the rate of changes of shoreline from different Series of time of shoreline locations. The extension was designed to assist the analysis of historical changes to the beach. The DSAS system work through the establishment of perpendicular segments (Chand and Acharya 2010). And then calculate the rate of changes and statistics associated with the chart of data. DSAS calculate a lot of statistical indicators such as, (LRR - JKR-EPR) (NASA، U.S. Geological Survey).

Results and Discussion

Many scientists studied the coastal erosion and they suggested many ways to measure the coastal retreat. The most common way is the baseline method and it was chosen in this research. This method is defined as the cross section method and used by Dolan, Hayden and Heywood, 1978 (Dolan et al. 1978).where the baseline was chosen parallel to the shoreline and adopted for all maps. and from near area of the shorelines during (1958-2010) to account the degree of changes by the meditation and perpendicular diversion with the line segments that have been created to conclude the rates of change

The establishment of trans sections and Standards of changes was automatically using special programs such as, DSAS which attached to program ArcGIS.

This extension contains elements identified the baseline and produced perpendicular videos to give clear clarification of shoreline and rate for its changes along the segments.in the analysis the rate of changes of the shoreline during the study period was calculated by the statistical technique (the end point rate). (EPR) (Dolan et al. 1991). Specific classification was adopted to clarify the values of (EPR) in selected areas of the study. The value zero indicates the full match of the shorelines. There is no erosion.no sedimentation.

The negative values have been given green color tones to indicate the erosion and a clear retreat of shoreline. While the positive values indicates the sedimentation in area and overcome the land over the sea to show the segments in red and his tones. It is to be noted that the cuts take to show the classification clearer and with more color tones to clarify accurately the used classification.

- **Alissawiyh area:** The baseline was established in parallel with the general directions of the shoreline. All transects were built on regular basis and with a distance (5m) along the beach and in length (100 m). At the end all transects (1046 transects) built and referenced in known order from east to west to give (EPR) the zero value along the line (Chand and Acharya 2010). Here the shoreline did not show any progress or retreat.but full match of the shorelines to be assured by the zero value of EPR. Fig2 (a).

- Alfaid land area: The equipment DSAS has produced (287) transects directed vertically in the shoreline with Distance (5 m) and with length of transects (200) was chosen to fit with the shoreline. Note that the total transects showed the overcome of land over the sea and it showed the transects color tones, close to the red color. EPR give positive values. The sedimentation is domination and the maximum value is (EPR=+1.81) in the northern section of the area and this is what have been previously interpreted and the minimum (EPR=0.07) indicates of the erosion about (5 m) Fig2 (b).

- Ibn hani area: The maximum value (EPR=0) and the minimum value is (EPR= -1) there is no value more than zero so. There is no sedimentation in this area here the baseline had determined and (381) transects were built in known order from east to west with distance of (1 m) and a length (75m) for transects to show the transects in green which indicates the domination of erosion and the map Fig2 (c).

- Al Kabir-Al Shamali river: After the comparison between the two shoreline clarify the retreat and the domination of the erosion over the sedimentation and transects showed in (609) in (5m) along the beach with length (200m) and in the known order from east to west to give the EPR negative values along the line. The maximum value between the chosen areas for the study (EPR=-2.8) faces the maximum recorded value (90m) and the highest value (EPR =-0.8). All the transects have negative values and the EPR zero value so there is no full match for the shoreline and there is no sediments but the domination of erosion in the area. The transects showed in dark green indicates the intensity of the erosion in the area the Fig 2(d).

- Al basia area: The equipment DSAS produced about (513) transects vertical on the shoreline in distance (5m) and length of transects (200m) was chosen to match the shoreline. To notice that the total transects appeared in green to show clear retreat of the shoreline as the segment show in red tones to give the EPR positive value too and the overcome of the land over the sea. The maximum value EPR =1.61+) indicates on sediments in the small Al bas gulf. Between the crossed tower in the

south where the ship home. And the Roman tower installed in hole was constructed in natural rocks and this rocks go deep in the sea to form a good barrier for the ships and exchange the different maritime business in this gulf. And we can consider it as a natural shelter. But it was prepared for temporary business and to provide the main needs. This percent here is an artificial human. The minimum value (EPR=-1.4) refer to intense erosion faces the value (60 m). The Fig 2 (e). After comparison the statistical result for the equipment DSAS with the degrees of erosion and sedimentation that has been recorded when we compare the two shoreline between (1958-2010) we have the highest statistical recorded value for erosion showed in the AlKabir Al shamali river area and that matches with the highest recorded erosion values (90m) in the same area. But the retreat and erosion has increased in the area especially after the construction of 16 tishreen dam in 1985. The amount of the sediments which was received by the sea has decreased because of the construction of the 16 tishreen dam to occuar the domination of the erosion over the sedimentation. With the concern the margin of errors in every chosen area of the study. The highest degree of sedimentation between the chosen areas of the study recorded in Al faid land (15m) to take EPR the highest value (+1.81).

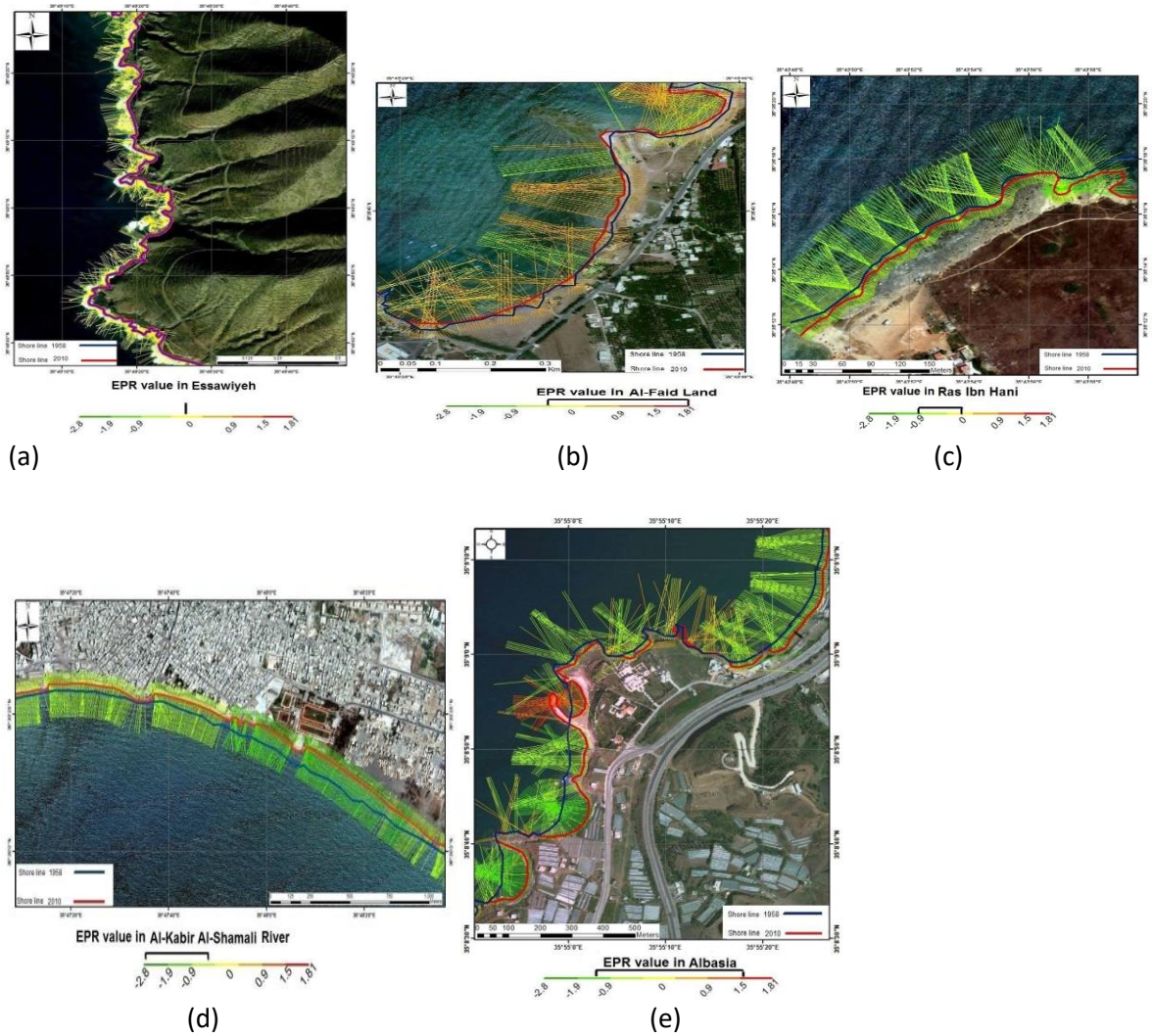

Figure 2: (a) The value of EPR in Al Issawiyah area Depending on the DSAS tool, (b) the value of EPR in Al faid land area Depending on the DSAS tool, (c) The value of EPR in Ibn Hani area Depending on the DSAS tool, (d) the value of EPR, In Al-kabir al-shamali river Depending on the tool DSAS, (e) the value of EPR in the Albasia area depending on the DSAS tool.

Conclusion

The integration of modern technology today and remote sensing with geographic information system (GIS) demonstrated a great ability to give useful approach to study the shoreline changes.

Thus, the study of the coasts and changes is critical important to conceive of what is happening and what can be done to protect in the light of current and emerging data expected.

Suggestions

1. To monitor of the part exposed to and try to address the continuing and through the establishment of a pier and the reinforcing concerts mortgages fixed stone to prevent leakage of the water to access to rock.
2. Proper and good administration of coastal regions as an example if it was to prevent the construction of the facilities and buildings near the beach. We can avoid many future problems concerning erosion result from storm until structural corrosion even if it temporary.
3. The dimensions of the facilities of roads. Bridges on the impact of the maritime erosion and risks through building marine barriers to protect properly from storm waves and coastal changes.
4. To work in installed the sand in the region through the transplant environment. And that the protection of the urban center of the going March of the sand where that plant is working to protect the shoreline of retreat before the operation of maritime insisted.
5. Interference in the natural sediments transfer process using the means of protection as the sand barriers and deep wall to strengthen the beach.
6. Artificial nutrition is one of the forms of protection of the beaches. Any protection that is artificially brought the sand from an external sources which it put in the coastal environment.

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